Volume: 28, Number: 1, April 2026, pp. 125-134
p-ISSN: 1410-8771, e-ISSN: 2580-4812
https://doi.org/10.37303/likhitaprajna.v28i1.966

LIKHITAPRAJNA Jurnal Ilmiah
Fakultas Keguruan dan Ilmu Pendidikan

SCAFFOLDING AND VIGNETTE-BASED LEARNING STRATEGY TO SUPPORT STUDENT ATTENTION IN LINEAR REGRESSION

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ARTICLE INFO

Article history:
Received March 2026
Revised March 2026
Accepted March 2026
Published 2 April 2026

Keywords:
Scaffolding
Vignette-Based Learning
Student Attention
Mathematics Learning
Single Subject Research

To cite this article:
Agustin, D., & Damayanti, N. (2026). Scaffolding and Vignette-Based Learning Strategy to Support Student Attention in Linear Regression. *Jurnal Likhitaprajna*, *28*(1), 125-134. https://doi.org/10.37303/likhitaprajna.v28i1.966

ABSTRACT

Students with attention difficulties often experience challenges in maintaining focus and sustaining engagement during mathematics learning. This study aimed to examine the implementation of scaffolding integrated with vignette-based learning in supporting student attention during linear regression instruction. This study employed a Single Subject Research (SSR) design using an A–B format, consisting of a baseline phase and an intervention phase. The research subject was one eleventh-grade student from a vocational high school who was selected using purposive sampling based on preliminary observation and teacher information indicating attention difficulties during mathematics learning. Data were collected through structured observation using 30-second interval recording, focusing on four attention indicators: latency, on-task behavior, prompting frequency, and distraction frequency. The data were analyzed using visual analysis to identify changes in level, trend, and variability across sessions. The results showed an increase in on-task behavior and a decrease in prompting frequency, indicating improved engagement and reduced reliance on external assistance. Distraction also decreased, although latency remained variable. The findings suggest that scaffolding integrated with vignette-based learning can support sustained attention and engagement through structured assistance and contextualized instruction. However, attention improvement was not entirely stable, particularly in task initiation.

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INTRODUCTION

Students with attention difficulties often experience challenges in maintaining focus, initiating tasks, and sustaining engagement during learning activities. These difficulties are particularly evident in mathematics learning, which requires continuous attention, sequential reasoning, and abstract thinking. Recent studies have shown that students with attention-related problems tend to exhibit low on-task behavior and high levels of distraction, which negatively affect their academic performance (Herzog & Casale, 2024; Singh et al., 2022; Türk et al., 2023; Yustika et al., 2023).

In the context of mathematics education, learning topics such as linear regression require students to understand relationships between variables, organize data, and represent information symbolically and graphically (Hasanah et al., 2021). However, students with attention difficulties often struggle with these processes, particularly in organizing data, interpreting coordinate systems, and maintaining consistency in task execution (Melzer & Herwix, 2024). Previous research indicates that difficulties in attention are closely related to weaknesses in executive functioning, including task initiation and sustained attention (Aadland et al., 2018). As a result, instructional strategies that provide structured support are needed to help students engage effectively in learning.

One instructional approach that is relevant to these attention-related and conceptual difficulties is scaffolding. Since students with attention difficulties may require support in initiating tasks, following sequential procedures, and maintaining engagement, structured instructional assistance is needed to help them participate more effectively in mathematics learning. Scaffolding refers to the provision of temporary and structured support that enables students to accomplish tasks beyond their independent capabilities (Li et al., 2023; Zurek et al., 2014). Several recent studies have demonstrated that scaffolding can improve student engagement, conceptual understanding, and learning outcomes, particularly for students who require additional support (Hofer & Reinhold, 2025; Kusmaryono & Wijayanti, 2025). By gradually reducing assistance through fading, scaffolding supports the transition from assisted performance to more independent learning.

In addition to scaffolding, contextual learning approaches such as vignette-based instruction can be used to make abstract mathematical concepts more meaningful. Vignettes present learning material in the form of short narratives or real-life scenarios, which can enhance students' interest and engagement (Chaloupka & Koppi, 1998). Research shows that contextual and narrative-based learning can support engagement and motivation, especially for students who experience difficulties in maintaining focus (Bondurant et al., 2025; Lohse-Bossenz et al., 2022). By providing meaningful contexts, vignette-based learning helps students connect abstract concepts with concrete experiences. This is also supported by studies showing that contextual and realistic learning approaches can improve conceptual understanding and engagement in mathematics learning (Listiawati et al., 2023).

Although scaffolding and contextual learning have been widely discussed, previous studies have generally examined these approaches separately. Studies that specifically investigate the integration of scaffolding with vignette-based learning in mathematics instruction for students with attention difficulties remain limited. Moreover, many previous studies have focused on group-based learning outcomes, while research using Single Subject Research (SSR) to analyze individual attention behavior in detail is still relatively scarce (Maric et al., 2023; Putri et al., 2025).

Therefore, this study aims to examine the implementation of scaffolding integrated with vignette-based learning in supporting the attention of a student with attention difficulties during linear regression instruction. Using a Single Subject Research design, this study provides a detailed analysis of behavioral changes, including on-task behavior, latency, prompting frequency, and distraction frequency. The findings are expected to contribute to the development of structured and contextualized instructional strategies for supporting students with attention difficulties in mathematics learning.

METHOD

Research Type

This study employed a Single Subject Research (SSR) design using an A–B format, consisting of a baseline phase (A) and an intervention phase (B) (Peltier et al., 2023). The baseline phase was conducted to identify the student's initial attention pattern before the implementation of scaffolding integrated with vignette-based learning, while the intervention phase was conducted to observe changes in student attention after the strategy was applied (Ledford & Gast, 2018; Tanious & Manolov, 2025). The research consisted of three sessions. The first and second sessions served as the baseline phase, while the third session served as the intervention phase. Each session lasted approximately 20 minutes.

Research Subjects

The subject of this study was one eleventh-grade student from the Visual Communication Design program at a vocational high school. The student was selected using purposive sampling based on preliminary observation and teacher information indicating attention difficulties during mathematics learning (Tajik et al., 2025). The observed attention difficulties included delayed task initiation, inconsistent attention, frequent distraction, and the need for repeated prompts during task completion. Therefore, this study involved one research subject.

Research Instruments

The main instrument used in this study was a structured observation sheet. The observation sheet was used to record four indicators of student attention: latency, on-task behavior, prompting frequency, and distraction frequency. Latency referred to the time needed by the student to begin working after the instruction was given. On-task behavior referred to the student's engagement in the assigned learning activity. Prompting frequency referred to the number of prompts provided by the teacher or observer to help the student continue the task. Distraction frequency referred to off-task behavior lasting more than one minute.

In addition, student worksheets, vignette-based learning materials, and learning documentation were used as supporting instruments. The worksheets were used to examine task completion and student responses, while documentation was used to support the interpretation of attention behavior during the learning process. The vignette-based learning material was designed using a contextual narrative task related to a zoo map to help the student connect coordinate representation and linear regression concepts with a concrete situation.

Data Collection Techniques

Data were collected through structured observation during mathematics learning sessions on linear regression. The observation was conducted using interval recording with 30-second intervals over a 20-minute session; therefore, each session consisted of 40 observation intervals. Interval recording was used to document the occurrence of on-task and off-task behavior systematically during the learning process (Burns et al., 2021).

During the baseline phase, which consisted of Sessions 1 and 2, the student completed linear regression tasks without the implementation of scaffolding integrated with vignette-based learning. During the intervention phase, which was conducted in Session 3, scaffolding was integrated with vignette-based learning through guided questioning, step-by-step assistance, clarification of task procedures, and contextual narrative tasks using a zoo map context.

Throughout each session, the observer recorded the student's latency, on-task and off-task behavior, prompting frequency, and distraction frequency. Student worksheets and learning documentation were also collected to support the analysis of behavioral changes and learning responses.

Data Analysis Techniques

The data were analyzed using visual analysis, which is commonly used in Single Subject Research. The analysis focused on changes in level, trend direction, and variability across the baseline and intervention phases (Tanious & Manolov, 2025).

The percentage of on-task behavior was calculated by dividing the number of on-task intervals by the total number of observation intervals and multiplying the result by 100.

Latency, prompting frequency, and distraction frequency were analyzed descriptively by comparing the patterns across Sessions 1, 2, and 3.

The baseline data from Sessions 1 and 2 were used to determine the student's initial attention pattern before the intervention. The intervention data from Session 3 were then compared with the baseline data to examine changes in attention after the implementation of scaffolding integrated with vignette-based learning. Since this study involved one participant, the interpretation focused on within-subject behavioral changes rather than generalization to a wider population.

RESULTS AND DISCUSSION

The results of student attention observations across the baseline and intervention phases are summarized in Table 1.

Table 1. Summary of Student Attention Indicators across Sessions

Indicator	Session 1 Baseline	Session 2 Baseline	Session 3 Intervention
On-task behavior (%)	47.5	55	72.5
Off-task behavior (%)	52.5	45	27.5
Prompting frequency	7	4	4
Latency (seconds)	90	66	83
Distraction frequency	5	2	3

Student Attention during the Baseline Phase

The baseline phase was conducted in Sessions 1 and 2 to identify the student's initial attention pattern before the implementation of scaffolding integrated with vignette-based learning. During Session 1, the student showed low and unstable engagement. The percentage of on-task behavior was 47.5%, while off-task behavior reached 52.5%. The student also required seven prompts and showed five distraction episodes lasting more than one minute. In addition, the latency in starting the task was 90 seconds, indicating that the student needed considerable time to initiate work after receiving instruction.

This condition suggests that the student experienced difficulties not only in maintaining attention but also in initiating tasks independently. The frequent shifts between on-task and off-task behavior indicate that the student's attention was still unstable and highly dependent on external support. This finding is consistent with previous studies showing that students with attention difficulties often experience challenges in task initiation, sustained attention, and behavioral regulation during academic activities (Aadland et al., 2018; Herzog & Casale, 2024; Singh et al., 2022).

In Session 2, the student's on-task behavior increased to 55%, while prompting frequency decreased to four prompts. Latency also decreased from 90 seconds to 66 seconds. These changes indicate a slight improvement in task readiness and learning engagement during the baseline phase. However, the student still showed fluctuating attention and required external assistance to continue the task. The student also experienced conceptual difficulties, particularly in constructing and interpreting the scatter plot. The student incorrectly placed the x-axis and y-axis and had difficulty arranging values on the coordinate system.

The improvement from Session 1 to Session 2 should be interpreted carefully because no intervention had been implemented yet. This change may reflect the student's increasing familiarity with the learning situation, observer presence, and task format. Therefore, the baseline data indicate that although the student showed some initial improvement, attention stability and conceptual independence had not yet been achieved.

Student Attention during the Intervention Phase

The intervention phase was conducted in Session 3 through scaffolding integrated with vignette-based learning. In this session, the student learned through a contextual narrative task using a zoo map. The intervention was implemented through guided questioning, step-by-step assistance, clarification of task procedures, and contextual prompts to help the student connect coordinate representation with a concrete situation.

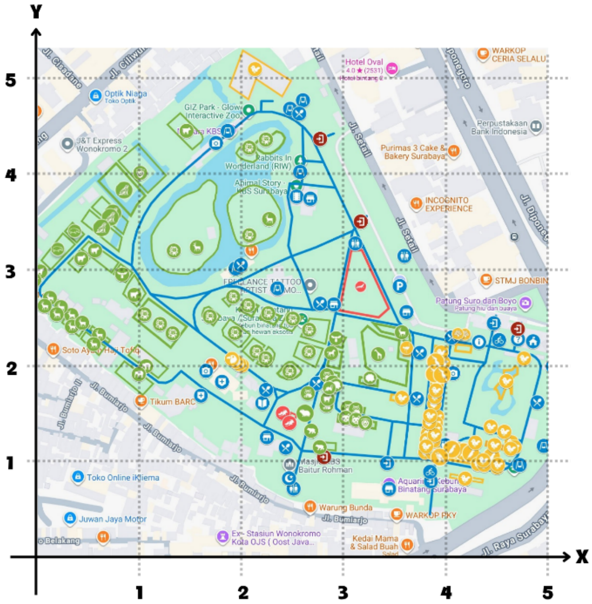

Figure 1. Vignette-Based Zoo Map Task Used during the Intervention Session

As shown in Figure 1, the zoo map task provided a contextual narrative that guided the student in connecting coordinate points with mathematical representation. The results showed that the student's on-task behavior increased to 72.5%, which was higher than both baseline sessions. Off-task behavior decreased to 27.5%. The student required four prompts, the same as in Session 2, but the quality of engagement appeared more stable. The student also showed fewer avoidance behaviors, as there was no repeated pattern of leaving the classroom during the intervention session. This suggests that the vignette-based context helped create a more meaningful and engaging learning situation for the student.

The increase in on-task behavior during the intervention phase may be explained by the use of contextualized learning materials. The zoo map scenario provided a concrete and familiar context that helped the student understand abstract mathematical ideas more easily. Contextual and narrative-based learning can support student engagement because it connects learning material with meaningful situations (Bondurant et al., 2025; Lohse-Bossenz et al., 2022). In this study, the narrative context appeared to reduce boredom and support sustained attention during the task.

Changes in Attention Indicators across Sessions

The comparison across sessions showed a positive change in the student's attention pattern. On-task behavior increased from 47.5% in Session 1 to 55% in Session 2 and reached 72.5% in Session 3. This increase indicates that the student became more engaged during the learning process, especially after the implementation of scaffolding integrated with vignette-based learning. The trend of attention indicators across the baseline and intervention phases is presented in Figure 2.

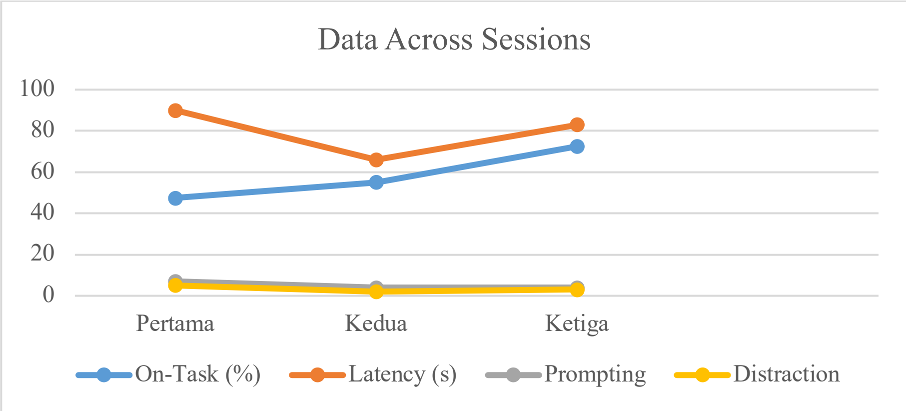

Figure 2. Visual Analysis of Student Attention Indicators across Sessions

As shown in Figure 2, on-task behavior increased across sessions. Meanwhile, prompting frequency decreased from seven prompts in Session 1 to four prompts in Sessions 2 and 3. The figure also shows that latency remained variable, while distraction frequency generally decreased across sessions. This decrease suggests that the student gradually required less external assistance to continue working on the task. From the perspective of scaffolding theory, this change indicates a movement from higher dependence on external support toward partial independence. Scaffolding provides temporary assistance that helps learners complete tasks beyond their independent ability, and such support can be gradually reduced as learners become more capable (Smit et al., 2013; Zurek et al., 2014).

However, latency showed an inconsistent pattern. The student's latency decreased from 90 seconds in Session 1 to 66 seconds in Session 2, but increased again to 83 seconds in Session 3. This finding indicates that improvement in sustained attention did not automatically lead to improvement in task initiation. The student was more engaged during the intervention session but still needed time to understand the initial instructions and begin the task. This supports the view that attention is multidimensional; maintaining attention and initiating a task may develop differently.

Distraction frequency also showed a generally positive pattern, decreasing from five episodes in Session 1 to two episodes in Session 2, before slightly increasing to three episodes in Session 3. Although the distraction frequency in Session 3 was not the lowest, the student's overall engagement was higher than in the baseline sessions. This suggests that the intervention did not eliminate distraction completely, but it helped the student return to the task and maintain engagement for longer periods.

Conceptual Understanding and Learning Behavior

Although the student's attention improved during the intervention phase, conceptual difficulties were still observed. In Session 2, the student had difficulty constructing the scatter plot, including errors in positioning the x-axis and y-axis. In Session 3, the student still made errors in writing coordinate pairs, such as reversing the order of coordinates.

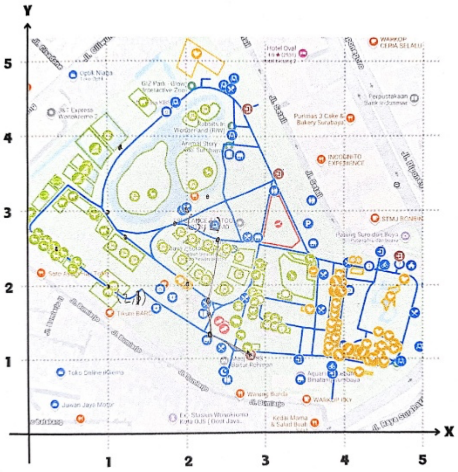

Figure 3. Student Errors in Coordinate Representation and Scatter Plot Construction

As shown in Figure 3, the student's errors indicate that coordinate representation had not yet been fully mastered and that conceptual scaffolding was still needed. Through guided questioning and step-by-step assistance, the student was able to continue the task and gradually connect the zoo map context with mathematical representation. This finding shows that scaffolding was not only useful for supporting attention but also for helping the student reconstruct conceptual understanding. The student still required prompts, but the prompts functioned as learning support rather than simply behavioral reminders.

The vignette-based task also appeared to support the student's interest. The contextual narrative helped the student relate mathematical concepts to a concrete situation, making the task more accessible and less abstract. This is consistent with previous research showing that narrative and embodied mathematical activities can support students in connecting mathematical ideas with concrete experiences (Gashaj et al., 2025). This is important in linear regression learning because students need to understand relationships between variables and represent them graphically. For students with attention difficulties, meaningful contexts can reduce cognitive barriers and support engagement during abstract mathematical tasks.

Discussion of the Findings

Overall, the findings indicate that scaffolding integrated with vignette-based learning supported the student's attention during linear regression instruction. The most visible improvement was found in on-task behavior, which increased across the three sessions and reached the highest percentage during the intervention phase. This suggests that structured assistance and contextual learning materials helped the student maintain engagement during the task.

The decrease in prompting frequency also indicates a positive change in learning behavior. Although the student still needed support, the number of prompts decreased compared with the first baseline session. This finding aligns with the principle of scaffolding, in which support is provided to help students complete tasks and gradually move toward greater independence (Vygotsky, 1978; Zurek et al., 2014).

Nevertheless, the findings should be interpreted cautiously. Because the intervention was implemented in only one session, the results cannot be claimed as strong evidence of effectiveness. The increase in on-task behavior suggests a positive change, but further sessions would be needed to determine whether the improvement was stable and directly related to the intervention. In addition, the inconsistent latency pattern indicates that task initiation remained a challenge even when sustained attention improved.

Therefore, the findings suggest that scaffolding integrated with vignette-based learning may support student attention, especially in increasing engagement and reducing reliance on prompts. However, additional intervention sessions are needed to strengthen the stability of the results and to provide stronger evidence of behavioral change.

CONCLUSION

This study investigated the implementation of scaffolding integrated with vignette-based learning to support the attention of a student with attention difficulties in learning linear regression. The findings indicate positive changes in student attention, particularly in increasing on-task behavior and reducing dependency on external prompts. The use of structured assistance and contextual narrative tasks helped the student maintain engagement and connect abstract mathematical concepts with concrete situations.

However, the results also revealed that attention improvement was not entirely stable, as indicated by the fluctuating pattern of latency. This suggests that while scaffolding integrated with vignette-based learning can support sustained engagement, task initiation may require longer intervention duration and more intensive support. Conceptual errors observed during the learning process also highlight the importance of combining behavioral support with conceptual scaffolding in mathematics instruction.

Despite these positive findings, this study has limitations. The limited number of sessions may affect the stability of the observed trends, and the use of a single participant restricts the generalizability of the results. Therefore, future studies are recommended to involve longer intervention periods, additional participants, and more rigorous SSR designs, such as A–B–A or multiple baseline designs, to strengthen experimental control.

Overall, this study provides preliminary evidence that integrating scaffolding with vignette-based learning can be a promising instructional strategy to support attention and engagement in mathematics learning for students with attention difficulties.

ACKNOWLEDGMENTS

The author would like to thank the school and mathematics teacher for their support and cooperation during the research process. The author also appreciates the participation of the student involved in this study, whose contribution made this research possible.

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